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# Study and Analysis of LTE-Advanced Systems at 2.6 GHz for Suburban Hall

**Nitish Chowdhary, Simranjeet Kaur, Sourabh Mahajan**
Department of Electronics & Communication Engineering
Sri Sai College of Engineering & Technology, Badhani, Pathankot, Punjab, India
Corresponding Email : snp09arya@gmail.com

***Abstract— In this work, Long Term Evaluation (LTE)-Advanced Systems for suburban hall C1 environment has been studied. The frequency selected is at 2.6 GHz. Three different modulation techniques have been applied as input to evaluate the performance of the WINNER II model system. The modulation techniques used are, Quadrature Phase Shift Keying (QPSK), 16 bit Quadrature Amplitude modulation (QAM) and 64 bit QAM. The results were simulated to evaluate the performance of the network graphically by evaluating the Signal to Noise Ratio (SNR) versus Bit Error Rate (BER) test. The analysis showed that the 64-bit QAM has better performance than the QPSK and 16-bit QAM modulation techniques.***

**Keywords— Long term evolution, QAM, QPSK, bit error rate, suburban hall C1, SNR.**

## I. Introduction

Communication networks are the patterns of contact that are created by the flow of messages among communicators through time and space. The concept of message should be understood here in its broadest sense to refer to data, information, knowledge, images, symbols and any other symbolic forms that can move from one point in a network to another or can be co-created by network members [1]. Wireless networks will enable people on the move to communicate with anyone, anywhere, at any time, using a range of multimedia services [2]. The exponential growth of cellular telephone and paging systems coupled with the proliferation of laptop and palmtop computers indicate a bright future for such networks, both as stand-alone systems and as part of the larger networking infrastructure. Wireless communications is the fastest growing segment of the communications industry. Cellular phones, cordless phones, and paging services have experienced exponential growth over the last decade, and this growth continues unabated worldwide. 3G telecommunications, is a generation of standards for mobile phones and mobile telecommunication services fulfilling the International Mobile Telecommunications-2000 (IMT-2000) specified by the International Telecommunication Union. The Application provided by 3G services consist of wide area wireless voice telephone, mobile Internet access, video calls and mobile TV, all in a mobile environment [3]. The main drawbacks of 3G communication system is that The cost of cellular infrastructure, upgrading base stations is very high, roaming and data/voice work collectively has not yet been implemented, and the power utilization is high requires closer base stations and are expensive. With 4GLTE, the user experience is better enhanced as the lower latency brings better experience in gaming and other graphics related software. LTE was initially planned by NTT DoCoMo of Japan in November, 2004 as the international standard [4]. Today different cellular and wireless firms want a major increase in capacity which has to be carried in coming years beyond fourth generation of wireless standards in Long Term Evolution (4GLTE) or 3GPP Long Term Evolution. 4GLTE network brings better benefits in its performance and capacity to both the end users and service providers. In the LTE network, there's a very low latency which enhances speed of the network because they are interconnected with other. The lower the rate of latency or delay in response time, the faster the interaction between the device and the network to which it is connected. Low latency in LTE is as a result of its support for games, application sharing, video and voice conferencing over IP. Hence, 4GLTE which is regarded as a seamless network uses only packet switching which makes data transfer done in nanoseconds compared to 3G network.

In this work, LTE-Advanced Systems under suburban hall C1 environment at 2.6 GHz has been studied and analyzed for different modulation techniques. QPSK, 16 bit QAM and 64 bit QAM has been studied to evaluate the performance of LTE-Advanced Systems. The rest of this paper is organized as follows: Section II describes the methodology related to this work, Section III shows the simulation results for different modulation factors; while Section IV concludes and summarizes the paper.

## II. Methodology

Long term evolution (LTE)- advanced system has been studied using Wireless World Initiative New Radio (WINNER) model under suburban hall C1 macrocell environment. The standard transmitter and receiver of WINNER model has been considered during this simulation. For this analysis, three different modulation techniques were used, that is, Quadrature Phase Shift Keying (QPSK), 16-bit Quadrature Amplitude Modulation (QAM) and 64-bit QAM. The model is used for generation of multidimensional channel matrix H, containing time-variant Channel-Impulse-Responses (CIR) between all transmitter and receiver antenna combinations of MIMO system. No doubt that the WINNER channel model is an antenna independent model. Hence antenna array model can be selected to obtain the signals at the output of the radio-channel. This model is deterministic and permanent from the viewpoint of the simulation, and can be created independently from channel model simulations. Uniform Linear Array (ULA) elements are placed along x-axis is such a way that the centre of the array is at origin of

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the 3-dimensional plane. In suburban macro-cells base stations are located well above the rooftops to allow wide area coverage, and mobile stations are outdoors at street level. Buildings are typically low residential detached houses with one or two floors, or blocks of flats with a few floors. Occasional open areas such as parks or playgrounds between the houses make the environment rather open. Streets do not form urban-like regular strict grid structure. Vegetation is modest. The input signal is transmitted through the relay channel with channel filtering. Then Additive white Gaussian noise (AWGN) was added. Now the receiver end of this data will be the receiving end of the relay. After receiving the data at the receiver of the relay, the Cyclic Prefix is removed, IFFT is applied and MMSE equalization is done. Then the IFFT is applied on the equalized data and the Cyclic Prefix (CP) is added. Then the data is transmitted through the access channel with channel filtering and adding Additive white Gaussian noise. At this point the received end is the receiver of the UE. Cyclic Prefix is removed from the received data, IFFT is applied and MMSE equalization is done. After that the hard detection is performed for evaluating the Bit Error Rate.

## III. Results and Discussions

The proposed work is studied using three different modulation techniques at fixed frequency. While studying QPSK modulation technique, the SNR vs Bit Error Rate curve for this scenario is shown in Figure 1.

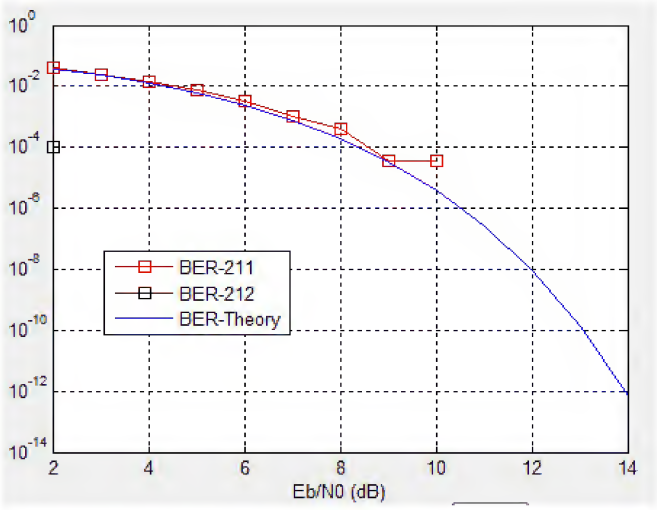


**Fig. 1:** SNR vs. BER for suburban hall C1 scenario with QPSK technique

From Figure 1, it is evident that environment exhibits that bit Error Rate are lower for theoretical value than BER-211. BER shows a continuous decreasing slope for 211 upto 9 dB vale, and after that BER becomes constant, while for theoretical value, it is decreasing throughout with the increase in SNR.

For 16-bit QAM, BER values are more improved than the previous case as is shown in Fig. 2. In QPSK, BER-212 was absent while in this case, BER-212 is present but with very steep inverse slope. Hence it decreases at much faster rate than the other cases for 16-bit QAM. The theoretical value remains more or less same but for BER-211 it decreases as per theoretical value as the SNR increases.

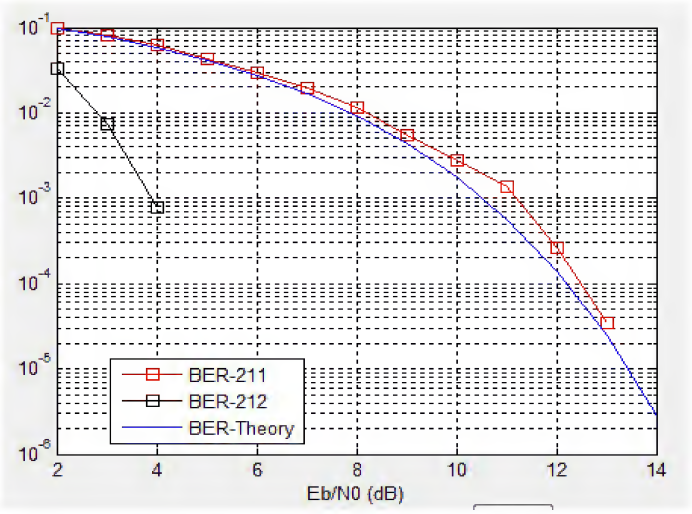


**Fig. 2:** SNR vs. BER for suburban hall C1 scenario with 16-bit QAM technique

The SNR vs bit Error Rate curve for this scenario with 64-bit QAM is shown in Figure 3.

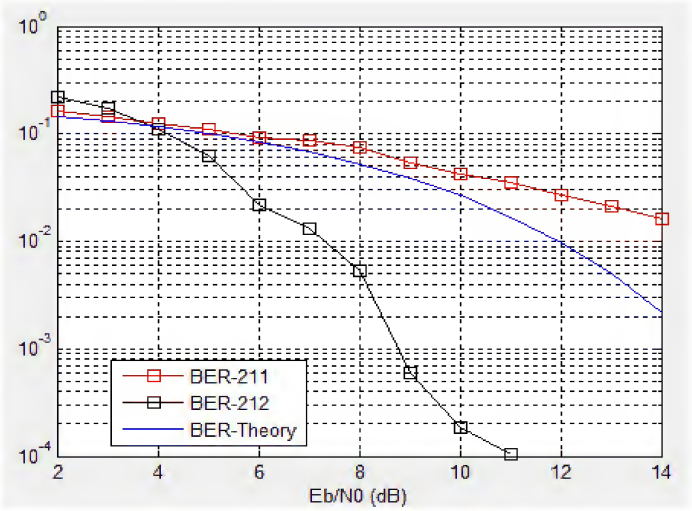


**Fig. 2:** SNR vs. BER for suburban hall C1 scenario with 64-bit QAM technique

In this scenario it is clear that 212 perform much better than the rest of the two. If we compare all the three cases, it is clear that 64-bit QAM has better performance than the other modulation techniques.

## IV. Conclusion

In this work, suburban hall C1 scenario has been studied to explore the feasibility of LTE-Advanced for different modulation techniques. WINNER II channel model is

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considered as the LTE channel model. Thus, this channel model is used to study C1 (suburban hall) scenario. This scenario is studied with one base station (BS) and one user equipment (UE). Thus, the results were analyzed for this simulated work to evaluate the performance of the network by performing the SNR vs BER test. We considered the simulations for different modulation techniques. The simulation results showed that the 64-bit QAM possess much better performance than the QPSK and 16-bit QAM modulation techniques.

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